Wind Cave Gating Management Plan
Wayne County, Kentucky

Prepared for:

EDP Renewables, North America

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EXECUTIVE SUMMARY

EDP Renewables (EDPR) has requested assistance from Western Ecosystems Technology, Inc. (WEST) in pursuing mitigation options to support the Headwaters Wind Farm (HWF) Habitat Conservation Plan (HCP) for federally endangered Indiana bats (INBA) and federally threatened northern long-eared bats (NLEB). This document describes the importance and location of a cave gating project, as well as pre-construction monitoring conducted to-date and proposed studies and monitoring to be conducted in the future.

Wind Cave is a Priority 2 INBA hibernaculum in Wayne County, Kentucky, and is considered to be the highest priority for gating in Kentucky due to human disturbance of hibernating bats. In addition to INBA and NLEB, little brown bat, tri-colored bat, eastern small-footed bat, big brown bat, and Rafinesque's big-eared bat have been observed to use the cave during harp trapping and winter hibernaculum counts. While up to 60 NLEB have been observed in the cave in the past, recent acoustic surveys failed to identify high levels of NLEB activity near the cave during fall swarming.

The proposed gate location is at a slight constriction inside the cave where bedrock, dry conditions, and lack of soil provide appropriate conditions for gate construction. The passage at this location is roughly oval in shape, and is a maximum of 5.3 meters (m; 17.3 feet [ft]) high by 12.3 m (40.3 ft) wide.

WEST conducted flight path monitoring during the fall of 2015 using thermal infrared and night vision equipment. Bat flight behavior at the proposed gate location consisted primarily of direct flights through the top 50% of the passage. Circular flights, consistent with swarming behavior, occurred closer to the cave entrance, and the proposed gate location appears to provide an appropriate location to place the gate.

In the fall of 2016, we propose to begin documenting pre-gating temperature and humidity in Wind Cave by placing two climate loggers in areas where INBA hibernate. Loggers will record data over the winter season, and will be retrieved in the spring of 2017.

After gate installation, the gate will be monitored for potential negative effects to bats, including effects on egress/ingress and swarming behavior, and on the temperature and humidity within the cave. In addition, the gate will be monitored annually to determine whether it continues to function effectively.

STUDY PARTICIPANTS

Western EcoSystems Technology, Inc.

Cara Meinke	Project Manager
Rhett Good	Senior Manager
Travis Brown	Field Supervisor
Ben Hale	Bat Biologist
Kevin Murray	Acoustic Expert
Aaron McAlexander	Bat Biologist
Rebecca Schmitt	Technical Editor
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REPORT REFERENCE

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ACKNOWLEDGEMENTS

We thank Erin O'Shea (EDP Renewables) for funding, Mike Armstrong (USFWS Kentucky Field Office) and Scott Pruitt (USFWS Indiana Field Office) for providing an opportunity to complete the project (as well as providing valuable input concerning logistics and methodology), Brooke Hines (formerly KDFWR) for early logistical support, and Lonzo Dishman for permission to conduct the studies on his property.

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INTRODUCTION

EDP Renewables (EDPR) has requested assistance from Western Ecosystems Technology, Inc. (WEST) in pursuing mitigation options in support of the Headwaters Wind Farm (HWF) Habitat Conservation Plan (HCP) for federally endangered Indiana bats (INBA, *Myotis sodalis*) and federally threatened northern long-eared bats (NLEB, *M. septentrionalis*). This document describes a proposed strategy for one potential mitigation project, the gating of Wind Cave in Wayne County, Kentucky.

INBAs are known to migrate from hibernacula in Kentucky to summer habitat as far north as Michigan (Kurta 2008); therefore, the protection of winter habitat in Kentucky will benefit INBA that establish maternity colonies in Indiana near the HWF, or that migrate through the HWF. Due to the fact that INBA and NLEB populations are currently being decimated by white-nose syndrome (WNS), protection of hibernacula from additional sources of stress is important. Wind Cave is considered by the USFWS (USFWS) Frankfort Field Office (FFO) and the Kentucky Department of Fish and Wildlife Resources (KDFWR) to be the highest priority cave left to be gated in Kentucky due to evidence of human disturbance to hibernating bats. The gating of Wind Cave represents an important conservation opportunity for both of these federally-listed species.

Wind Cave is a Priority 2 INBA hibernaculum. In 2015, the cave was home to 2,878 INBA (down from 3,537 observed in 2013; M. Armstrong, USFWS Kentucky Field Office [KFO], pers. comm.). As many as 60 NLEBs were observed in the cave in 2013, and one NLEB was observed in 2015. Other bat species known to use the cave include the little brown bat (*M. lucifugus*), tri-colored bat (*Perimyotis subflavus*), eastern small-footed bat (*M. leibii*), big brown bat (*Eptesicus fuscus*), and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*; M. Armstrong, pers. comm.).

The cave location is well-known to the public, the entrance is located near a road, and the landowner has noted use of the cave by trespassers. Use by humans during the swarming and hibernation periods creates disturbance to INBA since greater than 75% of hibernating population of INBA in the cave are clustered in low ceiling areas that are vulnerable to disturbance and/or predation. Therefore, the cave gating project will minimize the potential for federally-listed bats to be negatively affected by potential vandalism in the future, providing an important conservation benefit.

PROPOSED GATING LOCATION

The proposed gate location is approximately 35 meters (m, 115 feet [ft]) inside the entrance to Wind Cave. This area is relatively dry, and the bedrock found here provides an appropriate surface for mounting the gate. While the passage does constrict somewhat in this area, allowing a practicable location to install the gate, this location is not the most constricted portion of the cave passage. Two separate cave gate installers have identified this location as the appropriate area to build a gate (M. Armstrong, USFWS, pers. comm.). The passage in this area is shaped as an irregular oval, with a maximum ceiling height of approximately 5.3 m (17.3 ft) and a maximum width of roughly 12.3 m (40.3 ft; Figures 1, 2, and 3).

Figure 1. Photograph of the proposed Wind Cave gate location.

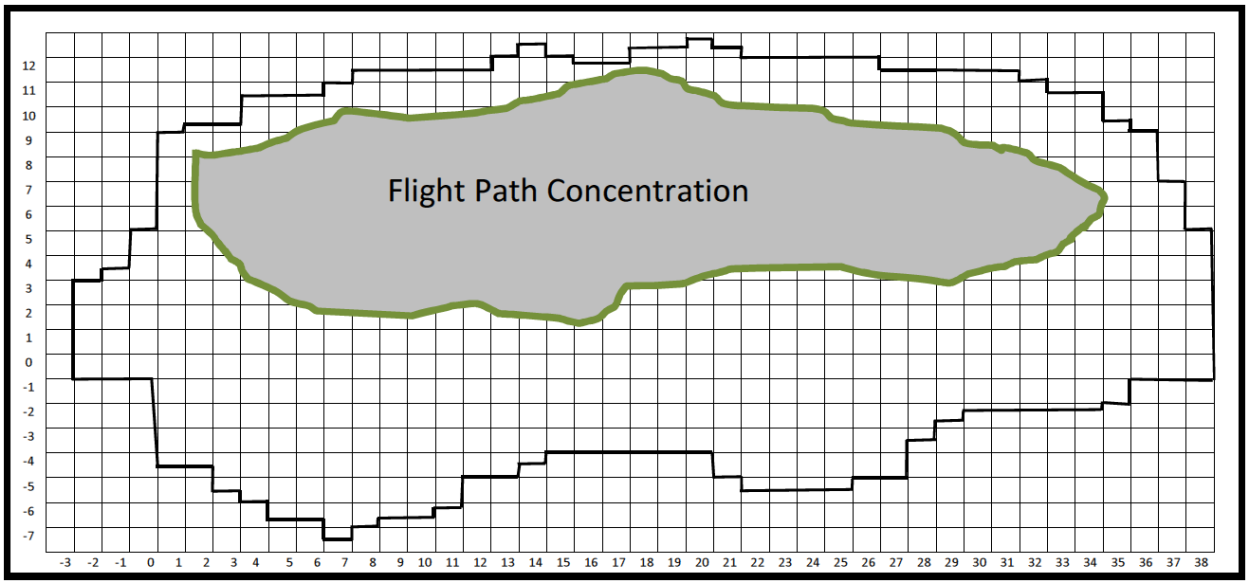

Figure 2. Area of use by exiting bats as observed by night vision active monitoring on September 29 and October 12, 2015 (grid cell size is 30 square centimeters [cm^2; 0.98 square feet (ft^2)]).

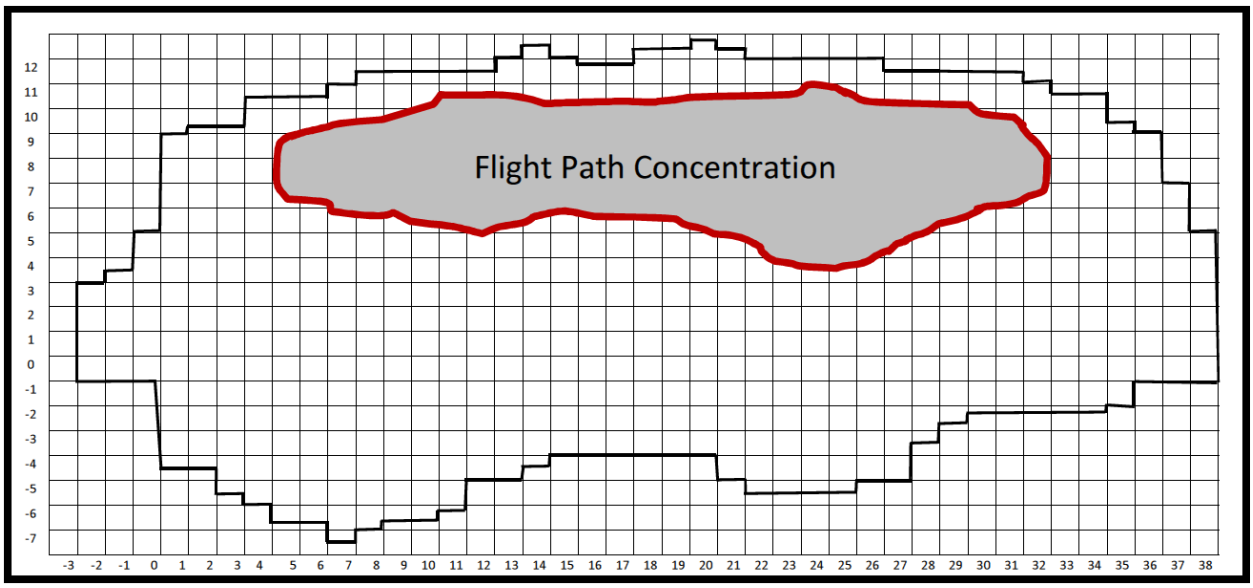

Figure 3. Area of use by exiting bats as observed by passive infrared thermal recording on September 29 and October 12, 2015 (grid cell size is 30 square centimeters [cm^2; 0.98 square feet (ft^2)]).

SUMMARY OF SURVEYS COMPLETED

Harp Trapping

A preliminary harp trapping survey was conducted at the entrance of Wind Cave on April 14, 2015 by KDFWR bat biologist B. Hines and two WEST biologists. The purpose of trapping was to gather additional information regarding use by NLEB. Trapping yielded three INBA, one little brown bat, one eastern small-footed bat, and one tri-colored bat before the survey was discontinued due to low temperatures and rain.

Acoustic Monitoring

WEST conducted acoustic monitoring at Wind Cave during the fall of 2015 in order to determine the level of NLEB activity near the cave (Brown et al. 2016). The ultimate objective of acoustic monitoring was to assess the utility of conducting an intensive spring harp trapping effort, which might be used to estimate the population of NLEB using Wind Cave. NLEB are not readily counted during winter hibernaculum surveys due to their habit of hibernating singly and in small crevices or cracks (USFWS 2014), and up to 60 NLEB had been observed in the cave in the past; therefore, high levels of NLEB acoustic activity would have been considered to be justification for spring harp trapping.

Acoustic activity of NLEB was very low in the vicinity of Wind Cave. During 51 detector nights, only three call files from NLEB were identified by automated software. Of these, only one file was confirmed as NLEB during qualitative review of the data. Brown et al. (2016) determined that it was unlikely that substantial numbers of NLEB currently occur in the cave; therefore, it was considered unlikely that the substantial effort and expense necessary to estimate NLEB

abundance in the cave (harp trapping for three nights per week for three weeks in the spring) was justified.

Flight Path Monitoring

WEST biologists conducted flight path monitoring at Wind Cave during the fall of 2015 in order to determine the likelihood of bat collisions or disruption of bat flight paths as a result of gate installation (Brown et al. 2016). Prior to monitoring, a cross-section drawing of the gate location was created, and two qualified bat biologists federally-permitted to survey for INBA and NLEB monitored the proposed gate location using Generation 3 night vision goggles (AN/PVS-7 Military Issue Goggle System, Optics HQ [no longer in business]) and outdoor thermal infrared (IR) network AXIS Q1910-E cameras (AXIS Communications, Sweden, Lund) for two nights of appropriate weather. Monitoring occurred for two hours each night after bats had begun flying from the entrance. Flight concentration polygons from field monitoring and thermal camera recordings were digitized and combined to produce minimum convex polygons representing locations where the majority of bats fly through the proposed gate location. Numbers of bats and their behaviors were also summarized using both observation methods.

Flight paths of exiting bats were concentrated in the top 50% of the proposed gate location using both night vision and IR technologies (Figures 2 and 3). More bats were observed and counted using IR recording equipment at a greater range compared to the use of night vision goggles. Using night vision goggles, the total emergence count on September 29, 2015, was 139 bats, and the total utilizing IR technology was 1,196 exiting bats. On October 12, 2015, the total emergence count was 136 bats using night vision goggles, and 115 bats using IR technology.

The majority of bat flights observed with both methods consisted of straight flight paths. On rare occasions, bats were observed flying in large arcs throughout the proposed gate area to the cave opening. These behaviors were relatively rare (less than 20 bats among the 1,311 bats that emerged) and were not representative of behavior observed in the gate area. Within two hours on both survey nights, bats that were observed to re-enter the cave did so via straight flight paths. On both survey nights, within two hours, bats were observed to re-enter the cave via straight flight paths.

Circular flights, consistent with swarming behavior, occurred closer to the cave entrance, particularly in an open area leading to a small passage directly to the left of the cave entrance (after entering the cave). This location is approximately 30 m (98 ft) from the proposed gate location and is closely associated with bats entering and exiting the cave entrance. The proposed gate location appears to provide an appropriate location to place the gate. This location is less likely to cause collisions than a gate located closer to the cave entrance, where more erratic flight paths occur during fall swarming.

PROPOSED STUDIES

In the fall of 2016, we propose to begin documenting pre-gating temperature and humidity in Wind Cave by placing two climate loggers (HOBO U23 v2 Temperature/Relative Humidity Data Loggers

or similar) in areas where INBA hibernate. Loggers will record data over the winter season, and will be retrieved in the spring of 2017.

PROPOSED MONITORING

Post-Construction Monitoring

The entrance of the cave will be monitored with thermal infrared camera equipment during the fall migration/swarming period of 2017 to monitor whether or not the newly installed gate is affecting egress/ingress and/or swarming behavior. Cameras will be placed in the cave and will record bat behavior for approximately two hours after bat activity is first observed. The cave entrance will be monitored for four nights during this critical period. The gate will be monitored concurrently by at least one federally-permitted bat biologist with night vision equipment. During monitoring, the timing, frequency, and duration of abnormal flight behaviors during egress and ingress (e.g., bats landing on the cave gate or crawling, rather than flying, through the gate) will be recorded. In addition, all potential predators and any observed predation events will be recorded.

Two climate loggers (HOBO U23 v2 Temperature/Relative Humidity Data Loggers or similar) will be placed in areas where INBA hibernate to monitor post-construction climate conditions for two years following construction. Speloggers or similar equipment will be installed within the Wind Cave entrance, and will be checked bi-annually to monitor human use. Data from speloggers will be downloaded, batteries will be changed, and general observations of conditions at the cave entrance will be recorded. Digital photographs will be taken of the cave entrance and gate to provide an annual record of damage, graffiti, trash, and signs of WNS (e.g., dead bats or bat bones) at the cave entrance. Monitoring will be conducted during the first three years of the mitigation project to provide the assurance that the gate was installed correctly and that it will function effectively through its operational life. In addition, Wind Cave will be regularly surveyed by the KDFWR on at least a biennial basis for the foreseeable future. However, if the KDFWR or the USFWS cannot continue monitoring their biennial monitoring efforts for any reason, EDPR will provide funding and personnel to continue monitoring efforts for the remainder of the Incidental Take Permit term. In such a case, at least one person with prior knowledge of the cave would be present during the first year of monitoring by EDPR-sponsored personnel.

WEST, in cooperation with the KDFWR and EDPR, will complete annual reports during the three-year monitoring period of the mitigation project, and the reports will be provided to the USFWS FFO and BFO. The reports will evaluate the effectiveness of the new gate in Year 1 (i.e., evaluation at the time of installation to determine that bats are not impeded by the gate during their passage into and out of the cave) and in subsequent years. The reports will discuss trends in microclimate data and make appropriate management recommendations to mitigate any issues discovered. To ensure that any required management actions can be implemented prior to the subsequent hibernation period, the mitigation monitoring report will be submitted annually by June 30.

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